CLAIMS

1. An electric power steering apparatus comprising:

a torque sensor for detecting a steering torque applied to a steering wheel;

a steering assist motor which is driven to rotate based on the steering torque detected by the torque sensor;

a drive circuit for driving the motor to rotate;

a judgment unit for judging whether a rotational speed of the motor is within a predetermined range; and

an instruction unit for supplying an instructing signal for field weakening control of the motor to the drive circuit, when it is judged that the rotational speed of the motor is within the predetermined range,

wherein the motor is a brushless motor comprising a rotor having a plurality of permanent magnets which are respectively fixed in a plurality of recesses provided in a rotor core.

2. The electric power steering apparatus according to Claim 1, wherein the rotor core is made of a plurality of electromagnetic thin steel plates which are laminated in an axial direction of a rotational axis so that the recesses fit shapes of the permanent magnets.

3. The electric power steering apparatus according to Claim 2,

wherein the brushless motor is set under field weakening control by controlling a phase of a motor current which is controlled with a PWM-controlled pulse signal, and

the predetermined range is a rotational speed range where a root-mean square value of an alternating signal corresponding to the pulse signal is within a range of 90% through 100% of a maximum root-mean square and where phase control is not performed.

4. The electric power steering apparatus according to Claim 3, further comprising:

a detector for detecting a ratio of the root-mean square value to the maximum value;

a judgment unit for judging whether the detected ratio is within a range of 90% through 100%; and

a switching unit for switching on/off phase control,

wherein a phase of the motor current is controlled by controlling a phase of the pulse signal, when the detected ratio is within a range of 90% through 100%.

5. The electric power steering apparatus according to Claim 4, further comprising:

a table which includes correlation between the steering torque and a target value of the motor current; and

a calculator for calculating a difference between the

detected steering torque and a preset threshold,

wherein the pulse signal is PWM-controlled based on a target value obtained with the table, when the detected ratio is under 90%, and

the difference is calculated and a phase of the pulse signal is controlled so as to decrease the difference, when the detected ratio is within a range of 90% through 100%.

6. The electric power steering apparatus according to Claim 1,

wherein the brushless motor is set under field weakening control by controlling a phase of a motor current which is controlled with a PWM-controlled pulse signal, and

the predetermined range is a rotational speed range where a root-mean square value of an alternating signal corresponding to the pulse signal is within a range of 90% through 100% of a maximum root-mean square and where phase control is not performed.

7. The electric power steering apparatus according to Claim 6, further comprising:

a detector for detecting a ratio of the root-mean square value to the maximum value;

a judgment unit for judging whether the detected ratio is within a range of 90% through 100%; and

a switching unit for switching on/off phase control,

wherein a phase of the motor current is controlled by controlling a phase of the pulse signal, when the detected ratio is within a range of 90% through 100%.

8. The electric power steering apparatus according to Claim 7, further comprising:

a table which includes correlation between the steering torque and a target value of the motor current; and

a calculator for calculating a difference between the detected steering torque and a preset threshold,

wherein the pulse signal is PWM-controlled based on a target value obtained with the table, when the detected ratio is under 90%, and

the difference is calculated and a phase of the pulse signal is controlled so as to decrease the difference, when the detected ratio is within a range of 90% through 100%.

9. An electric power steering apparatus comprising:

a torque sensor for detecting a steering torque applied to a steering wheel;

a steering assist motor which is driven to rotate based on the steering torque detected by the torque sensor;

a drive circuit for driving the motor to rotate;

means for judging whether a rotational speed of the motor

is within a predetermined range; and

means for supplying an instructing signal for field weakening control of the motor to the drive circuit, when it is judged that the rotational speed of the motor is within the predetermined range,

wherein the motor is a brushless motor comprising a rotor having a plurality of permanent magnets which are respectively fixed in a plurality of recesses provided in a rotor core.

10. The electric power steering apparatus according to Claim 9, wherein the rotor core is made of a plurality of electromagnetic thin steel plates which are laminated in an axial direction of a rotational axis so that the recesses fit shapes of the permanent magnets.

11. The electric power steering apparatus according to Claim 10,

wherein the brushless motor is set under field weakening control by controlling a phase of a motor current which is controlled with a PWM-controlled pulse signal, and

the predetermined range is a rotational speed range where a root-mean square value of an alternating signal corresponding to the pulse signal is within a range of 90% through 100% of a maximum root-mean square value and where phase control is not performed.

12. The electric power steering apparatus according to Claim 11, further comprising:

means for detecting a ratio of the root-mean square value to the maximum value;

means for judging whether the detected ratio is within a range of 90% through 100%; and

means for switching on/off phase control,

wherein a phase of the motor current is controlled by controlling a phase of the pulse signal, when the detected ratio is within a range of 90% through 100%.

13. The electric power steering apparatus according to Claim 12, further comprising:

a table which includes correlation between the steering torque and a target value of the motor current; and

means for calculating a difference between the detected steering torque and a preset threshold,

wherein the pulse signal is PWM-controlled based on a target value obtained with the table, when the detected ratio is under 90%, and

the difference is calculated and a phase of the pulse signal is controlled so as to decrease the difference, when the detected ratio is within a range of 90% through 100%.

14. The electric power steering apparatus according to Claim 9,

wherein the brushless motor is set under field weakening control by controlling a phase of a motor current which is controlled with a PWM-controlled pulse signal, and

the predetermined range is a rotational speed range where a root-mean square value of an alternating signal corresponding to the pulse signal is within a range of 90% through 100% of a maximum root-mean square and where phase control is not performed.

15. The electric power steering apparatus according to Claim 14, further comprising:

means for detecting a ratio of the root-mean square value to the maximum value;

means for judging whether the detected ratio is within a range of 90% through 100%; and

means for switching on/off phase control,

wherein a phase of the motor current is controlled by controlling a phase of the pulse signal, when the detected ratio is within a range of 90% through 100%.

16. The electric power steering apparatus according to Claim 15, further comprising:

a table which includes correlation between the steering

torque and a target value of the motor current; and

means for calculating a difference between the detected steering torque and a preset threshold,

wherein the pulse signal is PWM-controlled based on a target value obtained with the table, when the detected ratio is under 90%, and

the difference is calculated and a phase of the pulse signal is controlled so as to decrease the difference, when the detected ratio is within a range of 90% through 100%.